

CLAIMS

1. An image reproducing apparatus comprising:  
a buffer memory that accumulates input  
image data for a plurality of lines;  
5 an image data storing unit that extracts  
and stores, from the buffer memory, image data of a  
region of a predetermined size;  
a specified portion detecting unit that  
detects specified portion in which gradation of the image  
10 data varies slowly from the predetermined region of said  
image data stored in the image data storing unit; and  
an intermediate density data generating  
unit that generates intermediate density data composed  
with step smaller than the minimum value of a step  
15 between different gradation levels of said image data,  
based on a result of detection by said specified portion  
detecting unit, in said specified portion;  
wherein based on the intermediate density  
data, an image is output and reproduced that has a  
20 greater number of gradation levels than that of said  
input image data.

2. An image reproducing apparatus according to  
claim 1, further comprising an image output processing  
unit that outputs, on receiving said input image data and  
25 said intermediate density data, an image having increased  
number of gradation levels over that of the image data.

3. An image reproducing apparatus according to  
claim 1, wherein, in said specified portion, gradation  
varies in units of the minimum value of a step between  
30 different gradation levels of said image data, and  
wherein luminance of said image data in said specified  
portion is higher than in the other portion.

4. An image reproducing apparatus according to  
claim 2, wherein, in said specified portion, gradation  
35 varies in units of the minimum value of a step between  
different gradation levels of said image data, and  
wherein luminance of said image data in said specified

portion is higher than in the other portion.

5. An image reproducing apparatus comprising:

a buffer memory that accumulates input image data for a plurality of lines;

5 a register that extracts and stores, from the buffer memory, image data of a remarked pixel selected from among a plurality of pixels of said input image data, and image data of pixels in region surrounding the pixel; and

10 an image data operation processing unit that detects a portion containing said remarked pixel in which gradation of the image data varies slowly by calculating variation of gradation of image data in said surrounding region stored in the register, and generates  
15 intermediate density data composed with step smaller than the minimum value of a step between different gradation levels of image data;

wherein based on the intermediate density data, an image is output and reproduced that has a  
20 greater number of gradation levels than that of said input image data.

6. An image reproducing apparatus according to claim 5, further comprising a gradational print  
25 processing unit that performs, on receiving said input image data and said intermediate density data, a printing process of an image having increased number of gradation levels over that of the image data.

7. An image reproducing apparatus according to claim 5, wherein, in said portion containing said  
30 remarked pixel, gradation varies in units of the minimum value of a step between different gradation levels of said image data, and wherein luminance of said image data in said portion containing said remarked pixel is higher than in the other portion.

35 8. An image reproducing apparatus according to claim 6, wherein, in said portion containing said remarked pixel, gradation varies in units of the minimum

value of a step between different gradation levels of said image data, and wherein luminance of said image data in said portion containing said remarked pixel is higher than in the other portion.

- 5           9.    An image reproducing apparatus comprising:  
                  a buffer memory that accumulates input  
image data for a plurality of lines;  
                  a register that extracts and stores, from  
the buffer memory, image data of a remarked pixel  
10    selected from among a plurality of pixels of said input  
image data, and image data of pixels in region  
surrounding the pixel;  
                  an image data operation processing unit  
that calculates an average value of gradation of image  
15    data of said remarked pixel and image data of pixels in  
region surrounding said remarked pixel stored in the  
register; and  
                  a gradation enhancement process on/off  
deciding unit that detects the maximum value and the  
20    minimum value of gradation levels of image data in the  
region surrounding said remarked pixel, and decides  
whether or not enhancement process of increasing the  
number of gradation levels of said input image data is to  
be performed, depending on whether or not the difference  
25    between the maximum value and the minimum value is equal  
to or less than a predetermined value;  
                  wherein if the difference between said  
maximum value and said minimum value is equal to or less  
than the predetermined value, said gradation enhancement  
30    process on/off deciding unit is turned on to output and  
reproduce an image having a greater number of gradation  
levels than that of input image data, while if the  
difference between said maximum value and said minimum  
value is greater than the predetermined value, said  
35    gradation enhancement process on/off deciding unit is  
turned off to output and reproduce an image having  
adopted said average value as gradation level of image

data of said remarked pixel.

10. An image reproducing apparatus according to claim 9, further comprising a gradational print processing unit that performs, on receiving said input  
5 image data, a printing process of either an image having increased number of gradation levels over that of the image data, or an image having adopted said average value as gradation level of image data of said remarked pixel.

11. An image reproducing apparatus according to  
10 claim 9, wherein luminance of said image data in the portion containing said remarked pixel is higher than in the other portion.

12. An image reproducing apparatus according to  
15 claim 10, wherein luminance of said image data in the portion containing said remarked pixel is higher than in the other portion.

13. An image reproducing apparatus comprising:  
a buffer memory that accumulates input  
image data for a plurality of lines;  
20 a register that extracts and stores, from the buffer memory, image data of a remarked pixel from among a plurality of pixels of said input image data, and image data of pixels in region surrounding the pixel;  
a template storing unit that stores in  
25 advance the correspondence between arbitrary combination of said plurality of pixels and gradation having a greater number of gradation levels than that of said input image data as templates; and  
a coincidence detecting unit that detects  
30 whether or not a combination of a plurality of pixels in a template stored in the template storing unit coincides with the combination of said remarked pixel and pixels in region surrounding the pixel stored in the register;  
wherein if coincidence of said two  
35 combinations with each other is detected, an image having a greater number of gradation levels than that of said input image data is output and reproduced based on

corresponding gradation in said template.

14. An image reproducing apparatus according to claim 13, further comprising a gradational print processing unit that performs, on receiving said input  
5 image data, a printing process of an image having increased number of gradation levels over that of the image data.

15. An image reproducing apparatus according to claim 13, wherein luminance of said image data in the  
10 portion containing said remarked pixel is higher than in the other portion.

16. An image reproducing apparatus according to claim 14, wherein luminance of said image data in the  
15 portion containing said remarked pixel is higher than in the other portion.

17. An image reproducing apparatus comprising:  
a buffer memory that accumulates input image data for a plurality of lines;  
a first register that extracts and stores,  
20 from the buffer memory, image data of a remarked pixel from among a plurality of pixels of said input image data, and image data of pixels in region surrounding the pixel;  
a second register that sets the value of  
25 said remarked pixel as a reference value, and stores a result of subtraction of said value of said remarked pixel from value of pixels in said surrounding region as difference data;  
a difference template storing unit that  
30 stores in advance the correspondence between difference data of arbitrary pixel in said surrounding region and gradation having a greater number of gradation levels than that of input image data as difference template; and  
a difference coincidence detecting unit  
35 that detects whether or not difference data in difference template stored in said difference template storing unit coincides with the difference data stored in said second

register;

wherein if it is detected that the two difference data coincide with each other, an image having a greater number of gradation levels than that of said input image data is output and reproduced based on the corresponding gradation in said difference template.

18. An image reproducing apparatus according to claim 17, further comprising a gradational print processing unit that performs, on receiving said input image data, a printing process of an image having increased number of gradation levels over that of the image data.

19. An image reproducing apparatus according to claim 17, wherein luminance of said image data in the portion containing said remarked pixel is higher than in the other portion.

20. An image reproducing apparatus according to claim 18, wherein luminance of said image data in the portion containing said remarked pixel is higher than in the other portion.

21. An image reproducing apparatus according to claim 5, further comprising:

a resolution converting unit that converts a resolution of said input image data to a resolution of higher level than the original resolution; and

a position information register that stores position information on the position of each of said plurality of pixels;

wherein, while the position of each of said plurality of pixels stored in the position information register is being shifted pixel by pixel, said image data operation processing unit is operated so as to output an image which has the resolution of higher level than that of the input image data, and which has a greater number of gradation levels than that of the image data.

22. An image reproducing apparatus according to

claim 6, further comprising:

a resolution converting unit that converts a resolution of said input image data to a resolution of higher level than the original resolution; and

5 a position information register that stores position information on the position of each of said plurality of pixels;

wherein, while the position of each of said plurality of pixels stored in the position  
10 information register is being shifted pixel by pixel, said image data operation processing unit is operated so as to output an image which has the resolution of higher level than that of the input image data, and which has a greater number of gradation levels than that of the image  
15 data.

23. An image reproducing apparatus according to claim 7, further comprising:

a resolution converting unit that converts a resolution of said input image data to a resolution of  
20 higher level than the original resolution; and

a position information register that stores position information on the position of each of said plurality of pixels;

wherein, while the position of each of  
25 said plurality of pixels stored in the position information register is being shifted pixel by pixel, said image data operation processing unit is operated so as to output an image which has the resolution of higher level than that of the input image data, and which has a  
30 greater number of gradation levels than that of the image data.

24. An image reproducing apparatus according to claim 5, further comprising:

an image output on/off deciding unit that  
35 decides whether or not an image having a greater number of gradation levels than that of said input image data is to be output, depending on whether or not a gradation

level of image data in a region containing said remarked pixel is within a predetermined range;

5                    wherein, if the gradation level of image data in the region containing said remarked pixel is within the predetermined range, the image output on/off deciding unit is turned on to output an image having a greater number of gradation levels than that of said input image data, and on the other hand, if the gradation level of image data in the region containing said  
10 remarked pixel is not within the predetermined range, the image output on/off deciding unit is turned off to output an image having the number of gradation levels maintained at that of said input image data.

15                    25. An image reproducing apparatus according to claim 6, further comprising:

                    an image output on/off deciding unit that decides whether or not an image having a greater number of gradation levels than that of said input image data is to be output, depending on whether or not a gradation  
20 level of image data in a region containing said remarked pixel is within a predetermined range;

                    wherein, if the gradation level of image data in the region containing said remarked pixel is within the predetermined range, the image output on/off  
25 deciding unit is turned on to output an image having a greater number of gradation levels than that of said input image data, and on the other hand, if the gradation level of image data in the region containing said remarked pixel is not within the predetermined range, the  
30 image output on/off deciding unit is turned off to output an image having the number of gradation levels maintained at that of said input image data.

                    26. An image reproducing apparatus according to claim 7, further comprising:

35                    an image output on/off deciding unit that decides whether or not an image having a greater number of gradation levels than that of said input image data is



to be output, depending on whether or not a gradation level of image data in a region containing said remarked pixel is within a predetermined range;

5                    wherein, if the gradation level of image data in the region containing said remarked pixel is within the predetermined range, the image output on/off deciding unit is turned on to output an image having a greater number of gradation levels than that of said input image data, and on the other hand, if the gradation level of image data in the region containing said remarked pixel is not within the predetermined range, the image output on/off deciding unit is turned off to output an image having the number of gradation levels maintained at that of said input image data.

15                   27. An image reproducing apparatus according to claim 5, further comprising switching instructing means for instructing a switching operation as to whether an image having a greater number of gradation levels than that of said input image data is to be output, or an image having number of gradation levels maintained at that of said input image data is to be output.

20                   28. An image reproducing apparatus according to claim 6, further comprising switching instructing means for instructing a switching operation as to whether an image having a greater number of gradation levels than that of said input image data is to be output, or an image having number of gradation levels maintained at that of said input image data is to be output.

25                   29. An image reproducing apparatus according to claim 7, further comprising switching instructing means for instructing a switching operation as to whether an image having a greater number of gradation levels than that of said input image data is to be output, or an image having number of gradation levels maintained at that of said input image data is to be output.

30                   30. An image reproducing method comprising the steps of:

accumulating input image data for a plurality of lines in a buffer memory;

extracting and storing from the buffer memory image data of region of a predetermined size;

5 detecting a specified portion in which gradation of the image data varies slowly from the predetermined region of the stored image data;

generating intermediate density data composed with step smaller than the minimum value of a step between different gradation levels of said image data, based on the detection result of the specified portion, in the specified portion; and

10 outputting and reproducing, based on the intermediate density data, an image having a greater number of gradation levels than that of said input image data.

31. A computer readable storage medium storing:

means for causing image data of region of a predetermined size to be extracted and stored from a buffer memory storing input image data for a plurality of lines;

20 means for causing a specified portion where gradation of the image data varies slowly to be detected from the predetermined region of the stored image data;

25 means for causing intermediate density data composed with step smaller than the minimum value of a step between different gradation levels of said image data to be generated in said specified portion; and

30 means for outputting an image having a greater number of gradation levels than that of said input image data based on the intermediate density data.